the European Union and the U.S. Civilian Research Foundation, among others) tripled between 1995 and 1997 and now account for 7 percent of domestic R&D spending in Russia (CSRS 1999). In spite of these recent gains, real R&D spending remains 13 percent below the levels reported for 1992 and 75 percent below the estimated levels at the beginning of the decade. Furthermore, the outflow of researchers from such activities is still an important concern, as is the belief that the younger generation is not choosing science and engineering careers to the same extent as previously. Between 1995 and 1997, an estimated 65,000 scientists and engineers left their R&D work, resulting in a researcher workforce level (455,000) that was less than half of the estimated 1990 level (993,000).

International R&D by Performer, Source, and Character of Work

Performing Sectors

The industrial sector dominates R&D performance in each of the G-7 countries. (See figure 2-31.) Industry performance shares for the 1996–98 period ranged from a little more than 70 percent in the United States and Japan to less than 54 percent in Italy. Industry's share was between 60 and 70 percent in Germany, France, the United Kingdom, and Canada.[46] Most of the industrial R&D performance in these countries was funded by industry. Government's share of funding for industry R&D performance ranged from as little as 1 percent in Japan to 15 percent in the United States. (See appendix table 2-65.) By comparison, industry performance in Russia accounted for a 66 percent share of the total. However, government was the source of half of these funds (as contrasted with government's 15 percent or smaller shares in the G-7 countries), and industry itself funded just 40 percent of the Russian industrial R&D performance total.[47]

In most of these countries, the academic sector was the next-largest R&D performer (at about 12 to 25 percent of the performance total in each country).[48] Academia often is the primary location of research (as opposed to R&D) activities, however. Government was the second-largest R&D performing sector in France (which included spending in some sizeable government laboratories) and the U.S. (which includes FFRDCs), as it was in Russia (accounting for 28 percent of that nation's R&D effort). By comparison, government's R&D performance share was smallest in Japan, at about 10 percent of the country's total.

Sources of Funds

Industry R&D Funding

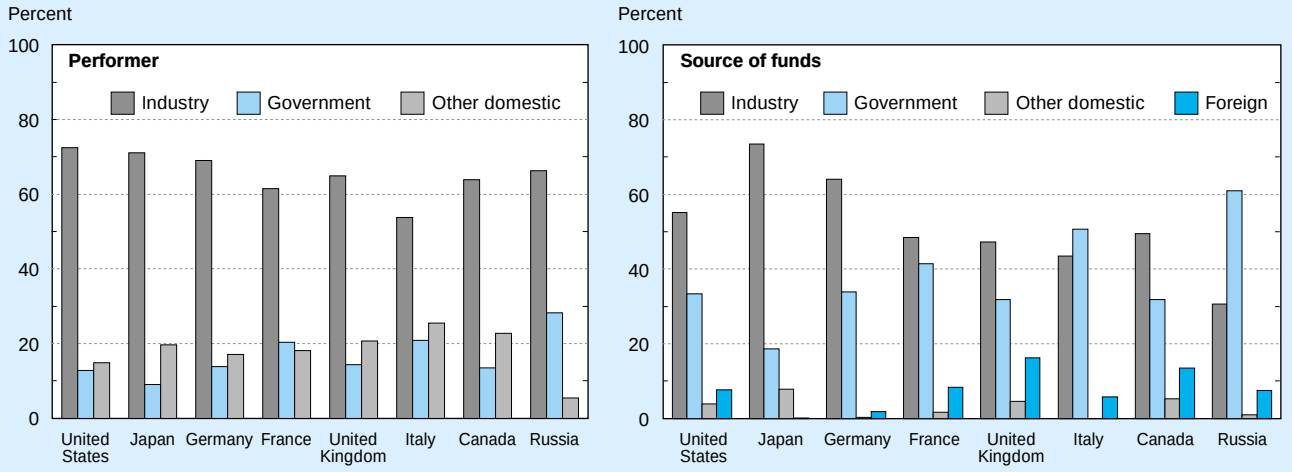
Consistent with the fact that the industrial sector performs most of these countries' R&D activities, it provides the great-

[46]See text table 2-13 for the distribution of industrial R&D performance in the G-7 countries and Sweden. For detailed data on industry-specific R&D activities in other OECD countries, see OECD 1999b.

[47]Although the economic structure of the Russian system still differs considerably from that of the G-7 countries, these data were compiled and adjusted by the Russian R&D statistics organization, CSRS (1999), according to OECD sector categories to allow international comparison.

[48]The national totals for Europe, Canada, and Japan include the research component of general university funds (GUF) block grants—not to be confused with basic research—provided by all levels of government to the academic sector. Therefore, at least conceptually, the totals include academia's separately budgeted research and research undertaken as part of university departmental R&D activities. In the United States, the Federal Government generally does not provide research support through a GUF equivalent, preferring instead to support specific, separately budgeted R&D projects. On the other hand, a fair amount of state government funding probably does support departmental research at public universities in the United States. Data on departmental research, considered an integral part of instructional programs, generally are not maintained by universities. U.S. totals may thus be underestimated relative to the R&D effort reported for other countries.

Figure 2-31.
R&D expenditures, by country, performer, and source: 1996–98



NOTE: Foreign performers are included in the "industry" and "other domestic" performing sectors.

See appendix table 2-65.

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est proportion of financial support for R&D in the G-7. Shares for this sector, however, differed from one country to another. Industry provided more than 70 percent of R&D funds in Japan; 64 percent in Germany; 55 percent in the United States; and between 44 and 49 percent in the United Kingdom, Italy, France, and Canada. In Russia, industry provided about 30 percent of the nation's R&D funding; government provided the largest share (61 percent of the country's 1997 R&D total). In most of these countries (except Russia and Italy, where it was largest), government was the second-largest source of R&D funding. In each of these eight countries, government provided the largest share of the funds for academic R&D performance.

Declining Government R&D

The most notable trend among the G-7 countries, however, has been the relative decline in government R&D funding in the 1990s. Indeed, this pattern of reduced governmental R&D support is apparent throughout the OECD, and especially in European countries (Caracostas and Muldur 1998). In 1997, roughly one-third of all R&D funds were derived from government sources—down considerably from the 45 percent share reported 16 years earlier. (See text table 2-16.) Among all OECD countries, government accounts for the highest funding share in Portugal (68 percent of its 1997 R&D total) and the lowest share in Japan (19 percent in 1996). Part of the relative decline reflects the effects of budgetary constraints, economic pressures, and changing priorities in government funding (especially the relative reduction in defense R&D in several of the major R&D-performing countries—notably France, the United Kingdom, and the United States). Part reflects the absolute growth in industrial R&D funding as a response to increasing international competitive pressures in the marketplace, irrespective of government R&D spending patterns—thereby increasing the relative share of industry's funding vis-á-vis government's. Both of these considerations are reflected in funding patterns for industrial R&D performance alone: In 1981, government provided 23 percent of the funds used by industry in the conduct of R&D within OECD countries, whereas by 1997 government's share of the industry R&D total had fallen by more than half, to 10 percent of the total. In most OECD countries (as in the U.S.), government support to business R&D is skewed toward large firms (OECD 1999a).

Rising Foreign R&D

The R&D funding share represented by funds from abroad ranged from as little as 0.1 percent in Japan to more than 16 percent in the United Kingdom. Foreign funding—predominantly from industry for R&D performed by industry—is an important and growing funding source in several countries and reflects the increasing globalization of industrial R&D activities overall. Although the growth pattern of foreign funding has seldom been smooth, it now accounts for more than 20 percent of industry's domestic performance totals in Canada and the United Kingdom and approximately 10 percent of industry R&D performed in France and Italy. (See figure 2-32.) Such funding takes on even greater importance in many of the smaller OECD countries, as well as in less industrialized countries (OECD 1999d). In the United States, approximately 8 percent of funds spent on industry R&D performance in 1996 are estimated to have come from majority-owned affiliates of foreign firms investing domestically. This amount was considerably more than the 3 percent funding share provided by foreign firms in 1980.[49]

[49]Unlike for other countries, there are no data on foreign sources of U.S. R&D performance. The figures used here to approximate foreign involvement are derived from the estimated percentage of U.S. industrial performance undertaken by majority-owned (i.e., 50 percent or more) nonbank U.S. affiliates of foreign companies. In short, the U.S. foreign R&D totals represent industry funding based on foreign ownership regardless of originating source, whereas the foreign totals for other countries represent flows of foreign funds from outside the country to any of its domestic performers.

Text table 2–16.
Sources of total and industry R&D performed in OECD countries, selected years
(Percent)

	1981	1986	1991	1997
OECD total R&D financed by				
Industry	51.2	54.1	58.7	62.3
Government	45.0	42.0	35.8	31.4
Other domestic sources	2.5	2.4	3.4	3.8
Foreign sources	1.3	1.5	2.1	2.5
OECD industry R&D financed by				
Government	22.6	21.8	15.0	10.2
Industry and other sources	77.4	78.2	85.0	89.8

NOTE: Includes all countries that were members of the OECD in the year reported, therefore the number of countries included may differ from one year to the next.

SOURCE: OECD Main Science and Technology Indicators Database (April 1999).

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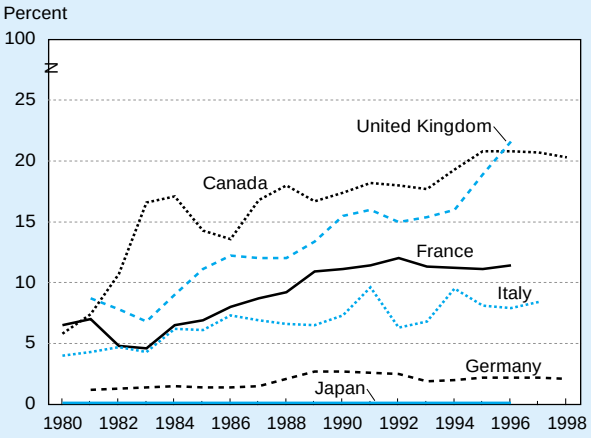
Figure 2-32.
Proportion of industrial R&D expenditures financed from foreign sources



See appendix table 2-72.

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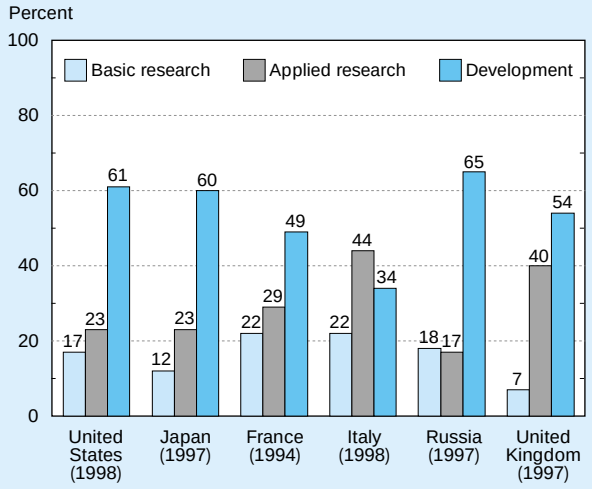
Character of R&D Effort

Not all of the G-8 countries categorize their R&D expenditures into character of work classifications (that is, basic research, applied research, or development), and for several countries that do utilize this taxonomy, the data are somewhat dated (OECD 1999c). Nonetheless, where these data exist, they are indicative of the relative emphasis that a country places on supporting fundamental scientific activities—the seed corn of economic growth and technological advancement.

The United States expends about 17 percent of its R&D on activities that performers classify as basic research. (See figure 2-33.) Much of this research is funded by the Federal Government and is performed in the academic sector. The largest share of this basic research effort is in support of the life sciences.

Basic research accounts for a similar portion (18 percent) of the R&D total in the Russian Federation. In comparison with U.S. patterns, however, a considerably greater share is for engineering research activities. In Japan, a comparatively smaller amount (12 percent) of the national R&D performance effort is for basic research, but as in Russia engineering fields receive the largest share of these funds. Conversely, basic research accounts for more than 20 percent of total R&D performance reported in Italy, France, and Germany. Furthermore, basic research would likely account for a similar share of the United Kingdom's R&D were these data available and published for the academic and nonprofit sectors—traditional locations for basic research activities. Except in Italy (where applied research was dominant), development activities accounted for the largest share of national totals, with most of the experimental development work underway in their respective industrial sectors.

Figure 2-33.
Distribution of R&D by character of work, in selected G-8 countries



NOTES: The character of work for 6 percent of Japan's R&D is unknown. The U.K splits are for industrial and government performers only. R&D character of work data for the higher education and nonprofit sectors (21 percent of the national total) are unavailable. For Germany, 21 percent of its 1993 R&D was basic research; the rest was undistributed. Canada does not report any of these data. Because of rounding, detail may not sum to totals.

SOURCES: Organization for Economic Co-operation and Development (OECD). 1999c. *Basic Science and Technology Statistics: 1998* (on diskette). Paris: OECD; Center for Science Research and Statistics (CSRS) 1999. *Russian Science and Technology at a Glance: 1998*. Moscow: CSRS.

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International Comparisons of Government R&D Priorities

The downturn in R&D growth within OECD countries has been disproportionately caused by flat or declining government funding of R&D since the late 1980s. These developments reflect and add to worldwide R&D landscape changes that present a variety of new challenges and opportunities. The following sections highlight government R&D funding priorities in several of the larger R&D-performing nations, summarize broad policy trends, and detail indirect support for research that governments offer their domestic industries through the tax code.

Funding Priorities by National Objective

A breakdown of public expenditures by major socioeconomic objectives provides insight into governmental priorities, which differ considerably across countries.[50] In the United States, 54 percent of the government's $74 billion R&D investment during 1998 was devoted to national defense. This share compares with the 38 percent defense share in the United Kingdom (of an $9 billion government total); 28 percent in France (of $13 billion); and 10 percent or less each in Germany, Italy, Canada, and Japan. (See figure 2-34 and appendix table 2-66.) These recent figures represent substantial cutbacks in defense R&D in the United States, the United Kingdom, and France—where defense accounted for 63 percent, 44 percent, and 40 percent of government R&D funding, respectively, in 1990. However, defense-related R&D also seems particularly difficult to account for in many countries' national statistics. (See sidebar, "Accounting for Defense R&D: Gap Between Performer- and Source-Reported Expenditures.")

[50]Data on the socioeconomic objectives of R&D funding are rarely obtained by special surveys; they are generally extracted in some way from national budgets. Because those budgets already have their own methodology and terminology, these R&D funding data are subject to comparability constraints not placed on other types of international R&D data sets. Notably, although each country adheres to the same criteria for distributing their R&D by objective—as outlined in OECD's Frascati Manual (OECD 1994)—the actual classification may differ among countries because of differences in the primary objective of the various funding agents. Note also that these data reflect government R&D funds only, which account for widely divergent shares and absolute amounts of each country's R&D total.